SDY
SUDDEN DEATH IN THE YOUNG
CASE REGISTRY

Introduction

This Guidance is a reference to assist you in completing the Sudden Death in the Young Autopsy Summary. It will guide you through the steps necessary to conduct a comprehensive autopsy of a sudden and unexpected death in a child or youth under age 20. It includes instructions for specific components of the autopsy.

The SDY Autopsy Guidance was developed as part of the SDY Case Registry, an initiative of the National Institutes of Health and the US Centers for Disease Control and Prevention. A committee of medical experts representing forensic pathology, cardiac pathology, neuropathology, pediatric medical specialties and death investigators developed this guidance.

Your jurisdiction is participating in the Sudden Death in the Young Case Registry with funding from the NIH and CDC. The autopsy findings will be summarized with other case review information and biospecimen data (upon family consent) into the SDY Case Registry. This Registry of de-identified data will be used to better understand the etiologies and risk factors for sudden death in the young so that improved prevention strategies may be developed.

Additional instructions and information are provided throughout this document in italics and footnotes.

SDY Definitions and Inclusion/Exclusion Criteria for the SDY Case Registry

"Sudden" implies death within 24 hours of the first symptom, or those resuscitated from cardiac arrest and dying during the same hospital admission.

"Unexpected" refers to a death in someone who dies from an accidental injury or someone who was believed to have been in good health, or had a stable chronic condition or had an illness but death was not expected. Examples could include hypertrophic or dilated cardiomyopathy, congenital heart disease, epilepsy, asthma and pneumonia.

Inclusion and Exclusion Criteria

This autopsy results summary sheet is a key component of the SDY Case Registry and should be used for all cases that meet all of the following inclusion criteria and none of the following exclusion criteria:

Inclusion Criteria

Is the child under 20 years old?	❑ Yes, Include	❑ No, Exclude
Was the death sudden and unexpected and/or unwitnessed?	❑ Yes, Include	❑ No, Exclude

Exclusion Criteria

Was the death caused by an accident in which the external cause was the obvious and only reason* for the death?	❑ Yes, Exclude	❑ No, Include
*Exception: All infants under 1 year of age whose death was caused by suffocation		❑ Include
Was the death an obvious homicide?	❑ Yes, Exclude	❑ No, Include
Was the death an obvious suicide?	❑ Yes, Exclude	❑ No, Include
Was the death caused by an accidental or intentional overdose of drugs even if this caused cardiac or respiratory arrest?	❑ Yes, Exclude	❑ No, Include
Was the death caused by a terminal illness in which the death was reasonably expected to occur within 6 months?	❑ Yes, Exclude	❑ No, Include

General

Sex: ❑ Male ❑ Female

Body weight: _____ kg Body length: _____ cm

Head circumference: _____ cm

External Exam: If abnormalities suggestive of trauma, disease/syndrome, or medical intervention, please describe:

_____

Photography (external) ❑ yes ❑ no

Imaging

(Circle all that were performed and describe the location)

X-Ray, single:

_____

X-Ray, multiple views:

_____

CT scan:

_____

MRI:

_____

Describe any abnormalities found on imaging:

_____

Detailed Review of Specified Organs

Thorax/Lungs

Thorax/Lungs Imaging:

- If there is a question about the possibility of extra lobar or intra-lobar sequestration, or congenital pulmonary adenomatoid malformation (CPAM; old name CCAM), remove the heart, lungs, central diaphragm, inferior vena cava, and descending aorta as a block, and send for pediatric pathology consultation.

Radiographs of chest ❑ Prior to death (hospital, emergency room, other) ❑ Postmortem

Thorax/Lungs – External Gross Examination

Chest:

Contour ❑ Normal ❑ Abnormal

If abnormal ❑ Increased anteroposterior diameter ❑ Asymmetry

Costal margin flaring ❑ Other: _____

Injuries ❑ Absent ❑ Present: _____

Axillary lymphadenopathy ❑ Absent ❑ Present

Other: _____

Nasal choanae (infants)[1] ❑ Patent ❑ Obstructed

[1]Testing to see if the nasal choanae are patent may be performed by sounding each nostril with a flexible probe. This can be performed with the nasopharyngeal swab for viral culture.

Thorax/Lungs – Internal Gross Examination

• *Photography: (optional)* ❑ *In situ* ❑ *On cutting board* • *Testing: sampling for viral and bacterial cultures (as indicated)*

Tracheal deviation ❑ Absent ❑ Present ❑ Left ❑ Right

Lungs:

- Pneumothorax ❑ Absent ❑ Present ❑ Left ❑ Right ❑ Bilateral
- If present, diagnosed by ❑ X-ray ❑ Other means: _____
- Hypoinflation[2] ❑ Absent ❑ Present ❑ Left ❑ Right ❑ Bilateral
- Lung(s) sunken towards the back ❑ Absent ❑ Present ❑ Left ❑ Right ❑ Bilateral
- Hyperinflation ❑ Lungs do not approach midline ❑ Approach midline ❑ Meet in midline
- Color ❑ Pink ❑ Dark red ❑ Alternating pink and purple ❑ Fibrinous/purulent exudate
  ❑ Dark red in all lobes, posterior only[3] ❑ Other: _____
- Pleural effusion ❑ Absent ❑ Present ❑ Left ❑ Right ❑ Bilateral
- If present, appearance ❑ Clear ❑ Bloody ❑ Straw ❑ Purulent ❑ Other: _____
  Amount: _____ ml

Hemidiaphragm elevation: ❑ Absent ❑ Present ❑ Left ❑ Right ❑ Bilateral

Thorax/Lungs – Gross Dissection

• *Take heart and lungs out as a block after inspecting aorta for vascular ring around trachea, and inspecting pulmonary arteries and veins (see heart section).*

• *The trachea / upper respiratory tract should be removed as a block with the lungs.*

Vascular ring (aorta around trachea) ❑ Absent ❑ Presentt

Lungs:

- Blood on the pleural surface (adherent hemothorax) ❑ Absent ❑ Present ❑ Acute ❑ Chronic
- Blood beneath the pleura ❑ Absent ❑ Present: Petechiae ❑ Confluent/Large hemorrhages
- Necrotic exudate on the pleural surface ❑ Absent ❑ Present
- Prominent/discolored/dilated lymphatics visible through the pleura ❑ Absent ❑ Present
- Cobblestoning[4] ❑ Absent ❑ Present
- Rib markings on the pleura ❑ Absent ❑ Present
- Other: _____

• *Perform the initial examination of the heart/lung block. If a cardiovascular pathology or pediatric pathology consultation is requested send the heart/lung block to consultant. If consultation is not requested separate the lungs from the heart following initial examination.*

Lung weights within normal range for age ❑ Yes ❑ No: ❑ Increased ❑ Decreased

Right lung approximately 1/3 heavier than the left lung ❑ Yes ❑ No: _____

Resuscitation-related changes ❑ Absent ❑ Present: _____

Pulmonary edema, NOS ❑ Absent ❑ Present: _____

Neurogenic pulmonary edema[5] ❑ Absent ❑ Present: _____

Pulmonary infection ❑ Absent ❑ Present: _____

Pulmonary hemorrhage ❑ Absent ❑ Present: _____

- If present: ❑ Diffuse ❑ Focal, location: _____ ❑ Aspiration pattern (follows bronchi)

Pulmonary hypertension[6] ❑ Absent ❑ Present

Other: _____

[2]Do the lungs approach each other or meet in the midline?
[3]Probable postmortem change
[4]Areas of pink hyperinflation and purple hypoinflation
[5]Consider SUDEP
[6]Muscle layers in subpleural arterioles

Thorax/Lungs – Gross Dissection (continued)

Abnormalities/disease processes visible at the hilum of either lung:

Pulmonary artery thromboemboli[7] ❑ Absent ❑ Present location: _____

Bronchial mucus/purulence ❑ Absent ❑ Present: _____

Bronchial aspirated food, foreign object ❑ Absent ❑ Present: _____

Other: _____

Is the right lung anatomically right-sided, and is the left lung left-sided:[8] ❑ Yes ❑ No

If no, partially divided lobes ❑ Absent ❑ Present: _____

Relationship of mainstem bronchus to mainstem pulmonary artery:[9]

❑ Normal: left hyparterial bronchus and right eparterial bronchus

❑ Left side is normal but right side is not (two left lungs)[10]

❑ Right side is normal but left side is not (two right lungs)[11]

❑ Neither side is normal[12]

• *Section through all lobes, central and peripheral, including mainstem bronchi.*

Hilar lymph nodes ❑ Normal ❑ Abnormal

If abnormal: ❑ Enlarged ❑ Anthracotic ❑ Granulomatous disease ❑ Hemorrhagic

❑ Gross infection ❑ Tumor deposits ❑ Other: _____

Aspiration ❑ Absent ❑ Present: _____

Atelectasis ❑ Absent ❑ Present: _____

Hyperinflation with/without mucus plugs[13] ❑ Absent ❑ Present: _____

Rib markings on pleura ❑ Absent ❑ Present: _____

Cobblestoning ❑ Absent ❑ Present: _____

Copious clear fluid ❑ Absent ❑ Present: _____

Copious blood-tinged fluid (from bronchi and/or parenchyma on sectioning) ❑ Absent ❑ Present

Hemorrhage ❑ Absent ❑ Present:

If present: ❑ Diffuse ❑ Focal, location: ❑ Aspiration pattern (follows bronchi)

Pneumonia/consolidation, exudate in bronchi, abscesses, or other signs of infection ❑ Absent ❑ Present

Cavitation ❑ Absent ❑ Present: _____

Granulomatous process[14] ❑ Absent ❑ Present: _____

Infarction/thromboemboli[15] ❑ Absent ❑ Present: _____

Tumor or suspected benign or neoplastic process ❑ Absent ❑ Present: _____

Congenital anomaly ❑ Absent ❑ Present: _____

Other: _____

[7]If there is any question whether blood clots in the mainstem pulmonary artery branches are antemortem thromboemboli or postmortem clot, histology is definitive.

[8]Three lobes on the right and two lobes on the left

[9]Does the main bronchus enter the hilum above, or approximately level with, the mainstem pulmonary artery branch on the right side (normal right eparterial bronchus), and below the mainstem pulmonary artery branch on the left side (normal left hyparterial bronchus)? If abnormal, consider pediatric pathology consultation.

[10]Look for polysplenia.

[11]Look for asplenia.

[12]Look for Kartagener syndrome.

[13]Consider asthma.

[14]Consider infection or sarcoidosis

[15]Propagation of thromboemboli causes red-purple "sausages" to exude from cross-sectioned pulmonary artery branches.

Thorax/Lungs – Microscopic Examination

- *Central*
- *Peripheral: including pleura and subpleural pulmonary artery branches and medium-sized bronchi*
- *Through areas of grossly evident or suspected disease processes*
- *There is no definitive number of lung sections supported by research that can be stated as required in every case. Peripheral and central lung samples each yield different diagnoses, and both should be sampled. Sampling from multiple areas may detect patchy diseases. Grossly suspicious areas are likely to reward sampling. Storage of multiple lung segments allows further sampling if disease processes are detected that require it. If in doubt, consult a pediatric pathologist.*
- *Obtain special stains as indicated for: -Bacterial infection -Granulomatous disease (acid-fast bacteria, sarcoidosis, fungi) -Autoimmune disease -Neoplasia -Resolving hemorrhage (iron)*

Aspiration ❑ Absent ❑ Present: -Food -Blood -Other:_____

Pulmonary edema ❑ Absent ❑ Present:_____

Alveolar hemorrhage ❑ Absent ❑ Present:_____

Hemorrhage in bronchial lumens ❑ Absent ❑ Present:_____

Red cell morphology ❑ Normal ❑ Typical postmortem ❑ Sickle cells on formalin-exposed tissue

Inflammation ❑ Absent ❑ Present

If present, location: ❑ Bronchi/bronchioles ❑ Alveoli ❑ Alveolar walls

Bronchus-associated lymphoid tissue ❑ Normal ❑ Abnormal:_____

Pulmonary thromboemboli ❑ Absent ❑ Present:_____

Secondary pneumonia around obstructed bronchi/infarcted lung parenchyma ❑ Absent ❑ Present

Chronic lung disease following prematurity ❑ Absent ❑ Present

Pulmonary hypertension or evidence of persistent fetal circulation[16] ❑ Absent ❑ Present

Asthma or other eosinophilic diseases ❑ Absent ❑ Present

Foreign bodies[17] ❑ Absent ❑ Present

Trachea:

- *Methods of examining the trachea should include opening along the long axis and cross-sectioning.*
- *The neck contents (proximal esophagus, trachea, thyroid gland, and overlying strap muscles) may be cross-sectioned together in one piece for histologic examination, particularly if tracheal/bronchial infection or narrowing of the lumen are of concern.*
- *Areas not cross-sectioned may be opened along the long axis. The epiglottis is easily sectioned. The aryepiglottic folds may be sectioned to look for eosinophils.*
- *The carina lends itself to a triangle-shaped sagittal cross-section that includes the carinal nodes.*
- *Trachea should be removed, including the hyoid bone, epiglottis, aryepiglottic folds, arytenoid cartilage, thyroid cartilage, trachea, and carina.*

Epiglottis ❑ Symmetrical ❑ Asymmetrical

Erythema ❑ Absent ❑ Present

Exudate ❑ Absent ❑ Present

Aryepiglottic folds ❑ Symmetrical ❑ Asymmetrical

❑ Flat (normal) ❑ Swollen

❑ Obstruct the lumen ❑ Do not obstruct the lumen

Vocal cords ❑ Symmetrical ❑ Asymmetrical

Abnormalities ❑ Absent ❑ Present:

Tracheal mucosa

Erosion ❑ Absent ❑ Present

Erythema ❑ Absent ❑ Present

Inflammation ❑ Absent ❑ Present:

Tracheal contents ❑ Absent ❑ Present

If present:_____

White foam, pink foam ❑ Absent ❑ Present

Mucus ❑ Absent ❑ Present

Necrotic exudate ❑ Absent ❑ Present

Thin layer of liquid blood along the mucosa ❑ Absent ❑ Present

Pieces of food, vomitus streaking the mucosa ❑ Absent ❑ Present

Obstructing blood clots ❑ Absent ❑ Present

Obstructing food bolus ❑ Absent ❑ Present

Foreign object ❑ Absent ❑ Present

[16]Including muscle layers in subpleural arterioles; other abnormalities of pulmonary artery branches

[17]Consider polarization to look for talc in granulomata.

Heart – Gross Dissection

- *Weigh the heart*
- *Make note of epicardial adhesions, exudate, or discoloration*
  -Make note of amount and distribution of epicardial fat
- *Section the epicardial coronary arteries at 3-5 mm intervals, avoiding cutting into great arteries and cardiac chambers*
  -Note arterial dominance (right/left/shared) and locations and degrees of obstructions
- *Make transverse (short axis) slices through the ventricles beginning 1 cm above the apex and at 1 cm intervals; do not section above the level of the tips of the left ventricular papillary muscles*
  -Note all gross lesions in the myocardial sections including scars, discolorations, and softenings
  -Lesions should described by the usual descriptors (e.g., size, color, firmness) as well as:
- *Vertical location (e.g., basal, midventricular, apical)*
- *Lateral location (e.g., anteroseptal, inferolateral)*
- *Distribution (e.g., subendocardial, transmural, subepicardial, random)*
  -Take measurements of left ventricular thickness, right ventricular thickness, and septal thickness in the uppermost (most basal) slice
- *When taking measurements, include only the compact myocardium; do not include trabecular muscle or papillary muscles*
  -Examine the right ventricular wall for fat infiltration
  -It is recommended that the myocardial slices be photographed, especially if there are grossly visible lesions
- *Open the heart in the direction of blood flow:*
  -Open the right atrium from the inferior vena cava orifice to the tip of the atrial appendage
- *Do not open through the superior vena cava orifice; doing so may cut through the SA node, hampering dissection of the conduction system if that is desired later*
  -Open from the right atrium to the right ventricle along the posterior or lateral wall
  -Open the right ventricular outflow tract anteriorly
  -Open the left atrium by connecting all of the pulmonary veins and cutting to the tip of the atrial appendage
  -Open from the left atrium to the left ventricle along the lateral wall
  -Open the left ventricular outflow tract anteriorly
- *Remove postmortem clot from all chambers*
  -If large amount of postmortem clot is present, consider re-weighing heart after the clot is removed
- *Describe degree of dilation of chambers, if any, and document presence/absence of mural thrombi*
- *Document presence/absence of patent foramen ovale, atrial septal defect, or ventricular septal defect (describe size and location if present)*
- *Examine the valves, noting number of leaflets/cusps of each and presence of any abnormalities (e.g., myxoid change, calcification, vegetations)*
- *Examine the coronary ostia*
  -If ectopic origin is present, note acuity of the origin (e.g., sharp angle of origin), course of the proximal segment of the artery (e.g., within aortic adventitia), and presence/absence of an occlusive ostial flap
- *If any of the above findings are present, it is recommended that they be photographed in addition to being described in the autopsy protocol*

Heart – Gross Examination

Heart weight_____ g ❑ Unfixed ❑ Fixed

Thoracic position ❑ Left (normal) ❑ Right ❑ Midline ❑ Ectopic: _____

Apex ❑ Leftward (normal) ❑ Rightward ❑ Other: _____

Spleen ❑ Single ❑ Accessory ❑ Polysplenia ❑ Asplenia

Liver ❑ Right (normal) ❑ Left ❑ Midline/ambiguous

Pericardial effusion ❑ Absent ❑ Present

If present: _____ ❑ Amount: _____ ml

Appearance ❑ Clear ❑ Straw ❑ Purulent ❑ Other: _____

Hemopericardium ❑ Absent ❑ Present

Vascular Ring ❑ Absent ❑ Present

Epicardium – Exudate ❑ Absent ❑ Present: _____

– Adhesions ❑ Absent ❑ Present: _____

– Fat ❑ Present, normal amount ❑ Increased ❑ Decreased

Right atrium – Morphology ❑ Right[18] (normal) ❑ Left ❑ Ambiguous/other: _____

– Venoatrial connections (SVC/IVC) ❑ Normal ❑ Abnormal: _____

– Coronary sinus os ❑ Patent ❑ Stenotic ❑ Atretic

– Dilation ❑ Absent ❑ Present: _____ ❑ Mild ❑ Moderate ❑ Severe

– Cavitary thrombus[19] ❑ Absent ❑ Present: _____

[18]Right atrial morphology includes presence of terminal crest, smooth endocardial surface posterior to terminal crest, pectinate muscles anterior to terminal crest and in atrial appendage. [19]Antemortem thrombus; excludes perimortem/postmortem clot.

Heart – Gross Examination (continued)

Left atrium

– Morphology ❑ Right[20] (normal) ❑ Left ❑ Ambiguous/other:_____

– Venoatrial connections (SVC/IVC) ❑ Normal ❑ Abnormal:_____

– Coronary sinus os ❑ Patent ❑ Stenotic ❑ Atretic

– Dilation ❑ Absent ❑ Present: _____ ❑ Mild ❑ Moderate ❑ Severe

– Cavitary thrombus ❑ Absent ❑ Present: _____

Atrial septum ❑ Intact ❑ Probe-patent foramen ovale ❑ Atrial septal defect:[21]_____

Atrioventricular valves ❑ Two valves (right and left) ❑ Common valve (atrioventricular canal[22])

Right atrioventricular valve

– Morphology ❑ Tricuspid (normal) ❑ Prosthetic: (type) _____ ❑ Other:_____

– Abnormalities ❑ Absent ❑ Present: If present, circle/describe all that apply:

– Vegetations _____ – Leaflet thickening _____

– Prolapse/ballooning _____ – Leaflet perforation _____

– Commissural fusion _____ – Apical displacement of septal leaflet (Ebstein's anomaly)

– Other:_____ _____

Left atrioventricular valve

– Morphology ❑ Mitral (bicuspid, normal) ❑ Prosthetic: (type) _____ ❑ Other: _____

– Abnormalities ❑ Absent ❑ Present: If present, circle/describe all that apply:

– Vegetations _____ – Leaflet thickening _____

– Prolapse/ballooning _____ – Leaflet perforation _____

– Commissural fusion _____ – Chordal thickening _____

– Chordal stretching/rupture _____ – Other: _____

Right ventricle

– Morphology ❑ Right[23] (normal) ❑ Left ❑ Ambiguous/other: _____

– Wall thickness[24] ❑ Anterior: _____ cm ❑ Posterior: _____ cm

– Fat infiltration[25] ❑ Absent ❑ Present ❑ If present, which wall: ❑ Anterior ❑ Posterior

❑ Maximum % thickness of wall involved: _____

– Right ventricular thinning[26] ❑ Absent ❑ Present ❑ Location: _____

– Dilation ❑ Absent ❑ Present: _____ ❑ Mild ❑ Moderate ❑ Severe

– Cavitary thrombus ❑ Absent ❑ Present: _____

– Endocardium ❑ Thin, translucent (normal) ❑ Abnormal:_____

Left ventricle

– Morphology ❑ Left[27](normal) ❑ Right ❑ Ambiguous/Other:

– Wall thickness[28] ❑ Anterior: _____ cm ❑ Lateral: _____ cm ❑ Inferior/posterior: _____ cm

– Dilation ❑ Absent ❑ Present: _____ ❑ Mild ❑ Moderate ❑ Severe

If present, chamber diameter (at same level as wall thicknesses): _____ cm

– Cavitary thrombus ❑ Absent ❑ Present:_____

– Endocardium ❑ Thin, translucent (normal) ❑ Abnormal: _____

– Myocardial infarction (acute/recent) ❑ Absent ❑ Present: _____

– Myocardial scar[29] ❑ Absent ❑ Present: _____

– Myocardial discoloration ❑ Absent ❑ Present: _____

[20]Left atrial morphology includes absence of terminal crest and smooth endocardial surface throughout atrium except for pectinate muscles in atrial appendage.

[21]Description should include location, size, and any intervention.

[22]Describe morphology and pathology under "Left atrioventricular valve" section.

[23]Right ventricular morphology includes coarse endomyocardial trabeculations and presence of a moderator band.

[24]Measurements should be taken at the level of the tips of the ventricular papillary muscles and should include only the compact myocardium (not epicardial fat or papillary/trabecular muscle).

[25]Concerning for arrhythmogenic right ventricular cardiomyopathy

[26]Concerning for arrhythmogenic right ventricular cardiomyopathy

[27]Left ventricular morphology includes fine endomyocardial trabeculations and absence of a moderator band.

[28]Measurements should be taken at the level of the tips of the left ventricular papillary muscles and should include only the compact myocardium (not epicardial fat or papillary/trabecular muscle).

[29]Includes remote myocardial infarctions

Heart – Gross Examination (continued)

Ventricular septum

Septal thickness[30] _____ cm ❑ Intact ❑ Ventricular septal defect[31] _____

Semilunar valves ❑ Two valves ❑ Single valve[32] (truncus arteriosus, pulmonary or aortic atresia)

If two valves: ❑ Aorta posterior and rightward of the pulmonary valve (normal)

❑ D-malposed[33] ❑ Other arrangement: _____

Right semilunar valve:

– Number of cusps ❑ 3 (normal) ❑ Other: _____ Prosthetic (type) _____

– Abnormalities: ❑ Absent ❑ Present: If present, circle/describe all that apply:

– Vegetations _____

– Thickening _____

– Calcification _____

– Perforation _____

– Commissural fusion _____

– Other: _____

Left semilunar valve

– Number of cusps ❑ 3 (normal) ❑ 2 (bicuspid) ❑ Other: _____ ❑ Prosthetic (type) _____

– Abnormalities: ❑ Absent ❑ Present: If present, circle/describe all that apply:

– Vegetations _____

– Thickening _____

– Calcification _____

– Perforation _____

– Commissural fusion _____

– Other: _____

Great vessels

– Pulmonary artery ❑ Normal ❑ Dilated ❑ Hypoplastic

– Discontinuous branch pulmonary arteries ❑ Absent ❑ Present

– Supravalvar pulmonary stenosis ❑ Absent ❑ Present: _____ ❑ Mild ❑ Moderate ❑ Severe

– Thromboemboli ❑ Absent ❑ Present: _____

– Aorta[34] ❑ Leftward arch (normal) ❑ Rightward arch

– Other arch anomaly (e.g., vascular ring) ❑ Absent ❑ Present: _____

– Root dilatation ❑ Absent ❑ Present: _____ cm (circumference)

– Dissection ❑ Absent ❑ Present: (type) Ruptured? ❑ Yes ❑ No

– Coarctation/Interruption ❑ Absent ❑ Present

– Supravalvar aortic stenosis ❑ Absent ❑ Present: _____ ❑ Mild ❑ Moderate ❑ Severe

– Ductus arteriosus ❑ Ligamentous (ligamentum arteriosum) ❑ Present, closed

❑ Probe patent ❑ Visibly patent: _____ mm (diameter)

Coronary arteries

– Ostia ❑ Normal[35] ❑ Abnormal: (e.g., stenosis) _____

– Distribution ❑ Normal, right dominant ❑ Normal, left dominant[36] ❑ Abnormal

If abnormal ❑ Single ❑ Left anterior descending from right ❑ Circumflex from right

❑ Other: _____

– Aneurysm ❑ Absent ❑ Present: _____

– Dissection ❑ Absent ❑ Present: _____

– Narrowing ❑ Absent ❑ Present: _____ ❑ Atherosclerotic ❑ Non-atherosclerotic

[30]Measurement should be taken at the level of the tips of the left ventricular papillary muscles.

[31]Description should include location, size, and any intervention. If malalignment is present (e.g., as in tetralogy of Fallot), describe extent and direction – anterior or posterior.

[32]Describe morphology/pathology in "Left semilunar valve"section.

[33]D-malposition is commonly referred to as "complete transposition" (i.e., aorta is anterior and rightward of the pulmonary artery).

[34]The aorta is the vessel that gives rise to the coronary arteries.

[35]"Normal" includes origin of the conus artery adjacent to right coronary ostium (normal variant).

[36]The right coronary artery may be small in left-dominant hearts. Describe in further detail in "Other" section if absent/hypoplastic or if downstream sequelae exist (e.g., myocardial infarction).

If atherosclerosis is present, fill out the following table:

Coronary Artery	Greatest % obstruction	Proximal √	Mid √	Distal √	Thrombus +/-	Calcification +/-
Left main						
Left anterior descending						
Diagonal						
Left circumflex						
Obtuse marginal						
Right						
Posterior descending						
Other						

Hypertrophic cardiomyopathy ❑ Absent ❑ Present Ventricular septal thickness[37] _____ cm

Dilated cardiomyopathy ❑ Absent ❑ Present

Left ventricular noncompaction ❑ Absent ❑ Present

Restrictive cardiomyopathy ❑ Absent ❑ Present

Congenital heart disease[38,39] ❑ Absent ❑ Present: (type) _____

Valve disease

– Mitral valve prolapse ❑ Absent ❑ Present

– Valve stenosis ❑ Absent ❑ Present: (location, severity) _____

Cardiovascular interventions present at autopsy[40] ❑ Absent ❑ Present

– Pacemaker: (make, model, type)
Interrogated? ❑ Yes ❑ No Results: _____

– Implanted defibrillator: (make, model)
Interrogated? ❑ Yes ❑ No Results: _____

– Implanted loop recorder: (make, model)
Interrogated? ❑ Yes ❑ No Results: _____

– Ventricular assist device: (type, location) _____

– Evidence of congenital heart surgery: (type, location) _____

– Stents/coils/plugs/occluder devices: (location) _____

– Other: _____

[37]"Normal" includes origin of the conus artery adjacent to right coronary ostium (normal variant).

[38]Probe patent foramen ovale is considered a normal variant and should not be included under congenital heart disease.

[39]Surgical status will be recorded under evidence of cardiovascular interventions

[40]With the exception of valve prostheses, which should be described in the valve sections above.

Heart – Microscopic Examination

The extent of microscopic examination is guided by the available history and the gross findings.

For a grossly normal heart, at a minimum:

- *2 sections of left ventricle that include the anterolateral and posteromedial papillary muscles*
- *1 section of basilar ventricular septum*
- *1 section of right ventricle*
- *An additional 4-6 sections of myocardium taken from a variety of locations in the ventricles and septum (to look for myocarditis, which can be patchy; if there is recent history of viral illness, it is advisable to take more)*

Myocardium:

- *Take sections of any areas of discoloration, softening, or mass.*
- *Taking sections of old myocardial infarction scars is usually uninformative, but areas of myocardium with randomly dispersed interstitial scars should be sampled.*
- *In cases of suspected hypertrophic cardiomyopathy, the ventricular septum should be carefully sampled to look for myocyte disarray.*
- *In cases of suspected arrhythmogenic right ventricular cardiomyopathy, multiple sections of the anterior and posterior walls of the right ventricle should be taken.*
- *Make note of:*
  - *-Hypertrophy*
  - *-Myocyte disarray*
  - *-Necrosis (coagulative vs. contraction-band; focal vs. geographic; specific distribution)*
  - *-Fibrosis (replacement vs. interstitial; specific distribution)*
  - *-Inflammation (prominent cell type(s); presence/absence of myocyte necrosis)*
  - *-Infiltrate (e.g., fat, amyloid)*
  - *-Epicardial surface (e.g., presence/absence of inflammation and exudate)*
  - *-Epicardial arteries (atherosclerosis)*
  - *-Intramyocardial arteries (thrombi, fibromuscular dysplasia)*

Coronary arteries:

- *Take sections of the greatest area of obstruction of each artery.*
- *Take sections of any other grossly visible lesion (e.g., aneurysm, dissection); consider including elastic stain.*

Valves:

- *Take sections of any vegetations (consider including Brown & Brenn tissue gram stain).*
- *Take a section of a mitral leaflet if it appears to have myxoid degeneration (include an Alcian Blue (AB)-Periodic acid-Schiff (PAS) stain).*

Conduction system:

- *Examination of the conduction system[41] should be done in all cases where:*
  - *-There is documented history of heart block, OR*
  - *-The decedent is an infant/small child and there is a known history of maternal lupus, OR*
  - *-Myxoid valvular disease is present.*
- *If number of histology blocks is not a financial consideration, doing microscopic examination of the conduction system should be considered in any apparent sudden cardiac death case.*

Brain – Gross Examination

- *Photographs should be taken with the brain in place and cranial vault removed. This is helpful for evaluation of brain swelling. All photographs should be made with a ruler.*

-Photographs:	*Vertex view*	*Right view*	*Left view*	*Base View*
Photographs	*-Epidural surface of dura mater*		*-Subdural surface of dura mater*	
	-Dorsal brain		*-Ventral brain*	
	-Right side of brain		*-Left side of brain*	
	-Evidence of surgical intervention			

Evidence of surgical intervention ❑ Absent ❑ Present: If present, circle/describe all that apply:

- Craniotomy: _____
- Craniectomy: _____
- Hardware in skull: _____
- Dural grafts: _____
- Tubes, drains: _____

Dural sinus thrombosis ❑ Absent ❑ Present: Sagittal Transverse

Subdural hemorrhage ❑ Absent ❑ Present: Left Right Bilateral

- If present: Amount _____ ml
  Color _____
  Appearance Clotted Liquid Shiny surface

[41] A stepwise description of the technique can be found in Gulino SP. Examination of the cardiac conduction system: forensic application in cases of sudden cardiac death. Am J Forensic Med Pathol 2003:24(3);227-38.

Brain – Gross Examination (continued)

Purulent material in subdural space ❑ Absent ❑ Present

– If present, bacterial culture obtained ❑ Yes, results: _____ ❑ No

Subarachnoid hemorrhage ❑ Absent ❑ Present

– If present Pattern: ❑ Diffuse ❑ Scattered ❑ Focal, location: _____

Severity: ❑ Mild ❑ Moderate ❑ Severe _____

Leptomeninges

– Clear ❑ Yes ❑ No: If no: _____

– Purulent material ❑ Absent ❑ Present

If present, bacterial culture obtained ❑ Yes, results: _____ ❑ No

– Clouding ❑ Absent ❑ Present

If present, bacterial and viral culture obtained ❑ Yes, results: _____ ❑ No

– Congestion ❑ Absent ❑ Present

Brain removed[42] ❑ No ❑ Yes: By pathologist By pathology resident By technician

Brain weight (unfixed)[43] _____ g

- *Fix brain in 10 – 20% buffered formalin for 2 weeks or longer.*[44,45]
- *Suspend brain so that is not deformed by container. This can be done by suspension with a thread under the basilar artery or by using concentrated formalin until the brain floats*
- *Request antemortem imaging reports if available for review prior to cutting.*

Brain weight (fixed): _____ g

Photographs: -Epidural surface of dura mater -Subdural surface of dura mater -Dorsal brain -Ventral brain
-Right side of brain -Left side of brain-evidence of surgical intervention

Intradural hemorrhage ❑ Absent ❑ Present

– If present Location: _____

Severity: ❑ Mild ❑ Moderate ❑ Severe

Subdural neomembrane ❑ Absent ❑ Present

– If present Location: Right cerebral Left cerebral Superior tentorium Inferior tentorium Posterior fossa

Color: _____

Gyral pattern ❑ Normal ❑ Aberrant:

– Polymicrogyria ❑ Absent ❑ Present, location(s): _____

Circle of Willis:

– Distribution ❑ Normal ❑ Abnormal: _____

– Obstruction ❑ Absent ❑ Present

– Size ❑ Normal ❑ Small ❑ Large Vessel(s): _____

– Aneurysm ❑ Absent ❑ Present

If present: Size _____ mm

Location: _____

Cranial nerves All present: ❑ Yes ❑ No: _____

Symmetric: ❑ Yes ❑ No: _____

Cingulate herniation ❑ Absent ❑ Present: Right Left

Uncal herniation ❑ Absent ❑ Present: Right Left Bilateral

Tonsillar herniation ❑ Absent ❑ Present: Right Left Bilateral Chronic[46] Acute

[42]Removal by forensic pathologist is recommended. This decreases the chances of artifacts, such as tearing of cranial nerves.

[43]Skip this step if the brain is very fragile and the brain can be fixed.

[44]Except in jurisdictions in which this is not allowed.

[45]In some jurisdictions the family must be notified if the brain is retained for fixation.

[46]As in a malformation such as Arnold Chiari

Brain – Gross Examination (continued)

Pontomedullary tear ❑ Absent ❑ Present: _____ Depth _____ mm

Cerebral hemispheres ❑ Symmetric ❑ Asymmetric: Right larger Left larger

Cerebellar hemispheres ❑ Symmetric ❑ Asymmetric: Right larger Left larger

Cerebellar folial sclerosis ❑ Absent ❑ Present, location: _____

Areas of softening ❑ Absent ❑ Present, location: _____

Areas of firmness ❑ Absent ❑ Present, location: _____

Surgical drains or other materials ❑ Absent ❑ Present

– If present Location: _____ Type of material: _____

Drains patent ❑ Yes ❑ No ❑ N/A

Shunts patent ❑ Yes ❑ No ❑ N/A

• *Separate brainstem/cerebellum by horizontal cut through the midbrain.*[47]

Aqueduct: Normal Obstructed Dilated

• *Cut the cerebrum in the coronal plane at 1.5 – 2.0 cm intervals.*
• *Separate the brainstem from the cerebellum by cutting the cerebellar peduncles.*
• *Divide the cerebellum in midline; slice each hemisphere with sagittal cuts at 0.5 cm intervals.*
• *Section the brainstem at 0.3 cm intervals.*
• *Photograph the cut brain sections.*[48]

Brain ❑ Symmetric ❑ Asymmetric: _____

Lateral ventricles ❑ Symmetric ❑ Asymmetric: Right larger Left larger

❑ Not Dilated ❑ Dilated: Mild Moderate Severe

Mass ❑ Absent ❑ Present: _____

Third ventricle ❑ Normal ❑ Dilated ❑ Obstructed

Fourth ventricle ❑ Normal ❑ Dilated ❑ Obstructed

Cortical ribbon

– Size ❑ Normal ❑ Narrow: _____ ❑ Diffuse ❑ Focal, location(s): _____

– Discoloration ❑ Absent ❑ Present: _____ ❑ Diffuse ❑ Focal, location(s): _____

White matter

– Distribution ❑ Symmetric ❑ Asymmetric: _____

– Discoloration ❑ Absent ❑ Present: _____ ❑ Diffuse ❑ Focal, location(s): _____

Myelination ❑ Normal for age ❑ Abnormal for age: _____

Hippocampi ❑ Symmetric ❑ Asymmetric: Right smaller Left smaller

Deep nuclei

– Distribution: ❑ Symmetric ❑ Asymmetric: _____

– Discoloration: ❑ Absent ❑ Present: _____ ❑ Diffuse ❑ Focal, location(s): _____

Pituitary

– Size ❑ Normal ❑ Small ❑ Large

– Necrosis ❑ Absent ❑ Present: _____

– Mass ❑ Absent ❑ Present: _____

– Areas of softness ❑ Absent ❑ Present

If present: Location(s): _____ Size: _____ mm

[47]Other techniques may be useful (e.g., sagittal sectioning of brainstem if pontomedullary tear suspected; sagittal sectioning of brainstem with cerebellum if Arnold Chiari suspected)

[48]Photographs of cut brain can be done in 2 to 6 photos with multiple sections in each. If abnormalities are found, photograph the involved brain section(s) with possible close-up views of the abnormalities.

Brain – Gross Examination (continued)

– Areas of firmness ❑ Absent ❑ Present: _____

If present: Location(s): _____ Size: _____ mm

– Areas of discoloration ❑ Absent ❑ Present

If present: Location(s): _____ Size: _____ mm

Color: _____

– Hemorrhage ❑ Absent ❑ Present

If present: Location(s): _____ Size: _____ mm

– Encephomalacia ❑ Absent ❑ Present

If present: Location(s): _____ Size: _____ mm

Stroke ❑ Absent ❑ Present: _____ ❑ Location: _____

Heterotopia ❑ Absent ❑ Present: _____ ❑ Location: _____

Arterio-venous malformation ❑ Absent ❑ Present: _____ Location: _____

Compression of cerebral hemisphere ❑ Absent ❑ Present

Anoxic ischemic encephalopathy ❑ Absent ❑ Present

Other congenital anomalies of the brain ❑ Absent ❑ Present, describe: _____

Brain – Microscopic Examination

- *Take sections of any abnormal areas*[49]
- *Also take sections of:*
  - *-Dura*[50]
  - *-Frontal cortex including subcortical white matter*
  - *-Parietal cortex including subcortical white matter*
  - *-Temporal cortex including subcortical white matter and ependymal surface*
  - *-Right hippocampus at level of lateral geniculate nucleus*
  - *-Left hippocampus at level of lateral geniculate nucleus*
  - *-Amygdala*
  - *-Hypothalamus*
  - *-Cerebellum including dentate nucleus and folia*
  - *-Midbrain*
  - *-Pons*
  - *-Medulla*
- *Keep sectioned brain in formalin until histologic examination is complete.*
- *Retain brainstem and hippocampi.*[51]

Gastrointestinal Tract – Gross Examination

External Examination

Abdominal distention ❑ Absent ❑ Present

-If present: Postmortem gas Asymmetry Fluid wave

Scar(s) from previous abdominal surgery ❑ Absent ❑ Present: _____

External feeding tube ❑ Absent ❑ Present: _____

Internal Examination

- *Photography: optional In situ On cutting board*
- *Testing: sampling for viral and bacterial cultures (as indicated)*

Peritoneal Cavity

– Evidence of peritonitis ❑ Absent ❑ Present: _____

– Ruptured abdominal organ ❑ Absent ❑ Present: _____

– Fluid accumulation ❑ Absent ❑ Present: _____

– Injury from resuscitation ❑ Absent ❑ Present: _____

[49]Sections should include borders between normal and abnormal areas.

[50]If subdural hemorrhage/neomembrane present, include interface with the normal dura.

[51]If jurisdiction allows.

Gastrointestinal Tract – Gross Examination (continued)

– Adhesions ❑ Absent ❑ Present: _____

– Previous surgery ❑ Absent ❑ Present: _____

– Hernia ❑ Absent ❑ Present: _____

If present: Incarceration: ❑ Absent ❑ Present: _____

– Volvulus ❑ Absent ❑ Present: _____

– Intussusception ❑ Absent ❑ Present: _____

– Appendicitis ❑ Absent ❑ Present: _____

– Foreign object in the peritoneum ❑ Absent ❑ Present: _____

- *Examine the tongue. During examination look for tongue bites if the child has teeth; examine the area of the foramen cecum for a visible or microscopic trace of the origin of the thyroid gland.*

Organ weights

Liver weight within normal range for age ❑ Yes ❑ No: Larger Smaller

If the liver is enlarged, does it appear to be a sequela of right heart failure (not a primary liver problem)? ❑ Yes ❑ No

- *Look at the epiglottis (may fall under respiratory/trachea).*
- *Open the esophagus, stomach, and duodenum, and consider opening the jejunum and ileum (strongly recommended).*
- *Open the large bowel.*
- *Use dissection or the squeeze test to evaluate whether the biliary tree passes bile.*
- *Open the gallbladder; optional, obtain bile for later evaluation.*
- *Section the liver and the pancreas.*
- *The pancreas may be sectioned with the duodenum and ampulla (preferred), or after separation from the duodenum.*

Evaluate grossly for:

Pancreatitis ❑ Absent ❑ Present: _____

Adhesions/sequelae of surgery
❑ Absent ❑ Present: _____

Bleeding ❑ Absent ❑ Present: _____

Thrombosis ❑ Absent ❑ Present, vessel: _____

Obstruction ❑ Absent ❑ Present: _____

Dilatation ❑ Absent ❑ Present: _____

Stenosis ❑ Absent ❑ Present: _____

Fistulas ❑ Absent ❑ Present: _____

Foreign objects
❑ Absent ❑ Present: _____

Masses - wall, including reduplications
❑ Absent ❑ Present: _____

Masses in the lumen
❑ Absent ❑ Present: _____

Intussusception
❑ Absent ❑ Present: _____

Volvulus ❑ Absent ❑ Present: _____

Toxic megacolon
❑ Absent ❑ Present: _____

Prolapse (rectal or other)
❑ Absent ❑ Present: _____

Reflux ❑ Absent ❑ Present: _____

Inflammation ❑ Absent ❑ Present: _____

Diarrhea ❑ Absent ❑ Present: _____

Constipation ❑ Absent ❑ Present: _____

Sequelae of necrotizing enterocolitis
❑ Absent ❑ Present: _____

Sequelae of G.I. diseases/infections[52]
❑ Absent ❑ Present: _____

Congenital abnormalities
❑ Absent ❑ Present: _____

[52]In neonates, systemic Herpes infection may include hepatitis.

Gastrointestinal Tract – Microscopic Examination

- *Take sections of any abnormal areas.*
- *Also take sections of:*
  - *-Tongue at foramen cecum (optional)*
  - *-Epiglottis (optional)*
  - *-Proximal esophagus (optional)*
  - *-Gastroesophageal junction, for reflux (required in infants; optional in children/young adults)*
  - *-Gastric wall (optional)*
  - *-Pyloroduodenal junction (recommended in infants; optional in children and young adults)*
  - *-Proximal duodenum (if evaluating for villous atrophy, some immunodeficiency syndromes, or parasites; optional otherwise)*
  - *-Ampulla of Vater with adjacent duodenum and head of the pancreas (optional)*
  - *-Tail of the pancreas (optional)*
  - *-Liver*
  - *-Gallbladder, biliary tree (optional)*
  - *-Jejunal and ileal sections (if evaluating for villous atrophy, enteritis, or parasites; optional otherwise)*
  - *-Ileocecal junction (recommended in infants; optional in children and young adults)*
  - *-Appendix tip or base (optional)*
  - *-Ascending or transverse colon (optional)*
  - *-Descending or rectosigmoid colon (recommended in infants and children; optional in children and young adults)*
  - *-Anorectum (optional)*

Infectious Diseases

Neurologic
- – Encephalitis ❑ Absent ❑ Present
- – Meningitis ❑ Absent ❑ Present

Respiratory
- – Pharyngitis ❑ Absent ❑ Present
- – Epiglottitis ❑ Absent ❑ Present
- – Bronchitis/bronchiolitis ❑ Absent ❑ Present
- – Pneumonia ❑ Absent ❑ Present

Cardiac
- – Myocarditis ❑ Absent ❑ Present
- – Endocarditis ❑ Absent ❑ Present

Gastrointestinal
- – Enterocolitis ❑ Absent ❑ Present

Other
- – Diffuse rash ❑ Absent ❑ Present
- – Soft tissue lesion ❑ Absent ❑ Present
- – Lymphadenitis ❑ Absent ❑ Present
- – Sepsis syndrome (e.g., disseminated intravascular coagulopathy) ❑ Absent ❑ Present
- – Urinary tract infection ❑ Absent ❑ Present
- – Other: _____

Specimens

The following should not be construed as requiring every sample for every examination, but should guide the autopsy physician's selection of specimens recovered based upon antemortem signs and symptoms and postmortem anatomic findings.

- Nasopharyngeal swab for viral culture
- Cerebrospinal fluid
- Blood cultures ❑ Aerobic ❑ Anaerobic
- Trachea ❑ Culturette ❑ Fresh tissue (obtained in a sterile fashion)
- Bronchus ❑ Culturette ❑ Fresh tissue (obtained in a sterile fashion)
- Lung culturette(s)
  - -Right upper lobe -Right middle lobe -Right lower lobe
  - -Left upper lobe -Left lower lobe
- Sterilely obtained fresh lung tissue
  - -Right upper lobe -Right middle lobe -Right lower lobe
  - -Left upper lobe -Left lower lobe
- Stool sample

Were additional specialists consulted on this autopsy (e.g., cardiac pathologist, neuropathologist)? ❑ Yes ❑ No

If yes, specify: _____

Gross Examination of Organs Summary Table

Organ	In situ exam	Gross weight of organ	Fixed or fresh (check)	Gross inspection (check box if normal; if not, describe abnormalities)	Sections retained[53]?
Brain (including leptomeninges)				❑ Normal	❑ Yes ❑ No
Neck structures[54]		Thyroid gland[55] Thymus	❑ Fresh ❑ Fixed	❑ Normal	❑ Yes ❑ No
Body cavities[56]			❑ Fresh ❑ Fixed	❑ Normal	❑ Yes ❑ No
Heart			❑ Fresh ❑ Fixed	❑ Normal	❑ Yes ❑ No
Kidneys			❑ Fresh ❑ Fixed	❑ Normal	❑ Yes ❑ No
Liver			❑ Fresh ❑ Fixed	❑ Normal	❑ Yes ❑ No
Lungs			❑ Fresh ❑ Fixed	❑ Normal	❑ Yes ❑ No
Pancreas			❑ Fresh ❑ Fixed	❑ Normal	❑ Yes ❑ No
Spleen			❑ Fresh ❑ Fixed	❑ Normal	❑ Yes ❑ No
GI tract			❑ Fresh ❑ Fixed	❑ Normal	❑ Yes ❑ No

[53]Small tissue samples in formalin.

[54]Neck structures include: epiglottis, aryepiglottic folds, arytenoid and thyroid cartilage to include the vocal cords, cricothyroid membrane, the cricoid cartilage and the tracheal rings, thyroid gland, strap muscles, and the vessels and nerves including those within the carotid sheath and tongue. Under 1 y.o. include the subglottic musculature.

[55]In infants the thyroid may be too small to weigh.

[56]Body cavities include the pleural, peritoneal and pericardial cavities and pelvis.

Tissue Sampling and Histology

Sampled Tissue	Number of Sections	Describe Abnormalities
Airways		
Brain including leptomeninges		
Heart		
Kidneys		
Liver		
Lungs		
Pancreas		
Spleen		
Thymus		
Bone or costochondral tissue		Location: Abnormalities:
Endocrine organs[57]		
Gastrointestinal tract		

[57]Endocrine organs include: adrenal glands, pituitary gland, and the thyroid gland. The testes/ovaries can also be included.

Ancillary Testing

Testing	Describe Testing Performed	Results
	E.g. lab name and type of testing (toxicology panel or genetic testing for Long QT, etc...)	Circle Normal or Abnormal **If Abnormal, Describe**
Microbiology/cultures for infectious disease		❑ Normal ❑ Abnormal If abnormal, describe:
Postmortem metabolic screen		❑ Normal ❑ Abnormal If abnormal, describe:
Toxicology		❑ Normal ❑ Abnormal If abnormal, describe:
Vitreous testing		❑ Normal ❑ Abnormal If abnormal, describe:
Genetic testing		❑ Normal ❑ Abnormal If abnormal, describe:
Other, specify:		❑ Normal ❑ Abnormal If abnormal, describe:

Final Pathologic Diagnosis

Was the family referred to a tertiary care center with subspecialty expertise relevant to the cause of death (e.g., cardiology, neurology) for screening of at-risk relatives and genetic counseling?

❑ Yes ❑ No ❑ N/A

Where:

SUDDEN DEATH IN THE YOUNG
CASE REGISTRY

Sudden Death in the Young Case Registry Data Coordinating Center
c/o Michigan Public Health Institute
2455 Woodlake Circle
Okemos, MI 48864
Telephone: 800-656-2434 Email: info@SDYregistry.org Fax: 844-816-9662